

Claims

1. A coating composition comprising

a1) a physically drying film forming binder resin or resins;

5 a2) a thermally cross linking film forming binder resin or binder resins;

a3) a radiation curable film forming binder resin or binder resins;

a4) an autoxidatively drying film forming binder resin or resins; or

a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

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b) a polymer or copolymer levelling agent of formula (I)  $\text{In}-[(\text{M})_x-(\text{E})_y]_n$  (I) obtained by nitroxyl mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

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M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters or methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters which are substituted by amino, (C<sub>1</sub>-C<sub>22</sub>)alkylamino, (C<sub>1</sub>-C<sub>22</sub>)dialkylamino, -SO<sub>3</sub>H, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, N,N-di(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

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provided that the amount of unsubstituted acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters or/and methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters is more than 30 % by weight based on the weight of the total monomer mixture;

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E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

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y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)<sub>x</sub>;

n is a number from 1 to 20; and

c) optionally water or/and one or more organic solvents.

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2. A coating composition according to claim 1 comprising  
 a2) a thermally cross linking film forming binder resin or binder resins; or  
 a3) a radiation curable film forming binder resin or binder resins.

5 3. A coating composition according to claim 1 comprising  
 a2) a thermally cross linking film forming binder resin or binder resins.

4. A coating composition according to claim 1 comprising  
 a2) a thermally cross linking film forming binder resin or binder resins without water and  
 10 organic solvent, which is in the form of a solid powder.

5. A coating composition according to claim 1 wherein the polymer or copolymer levelling  
 agent of formula (I), is obtained by

b1) polymerization in the presence of an alkoxyamine initiator/regulator having the structural

15 element  $\begin{array}{c} \diagup \\ \text{N}-\text{O}-\text{X} \\ \diagdown \end{array}$  ; or by

b2) polymerization in the presence of a stable nitroxyl free radical having the structural

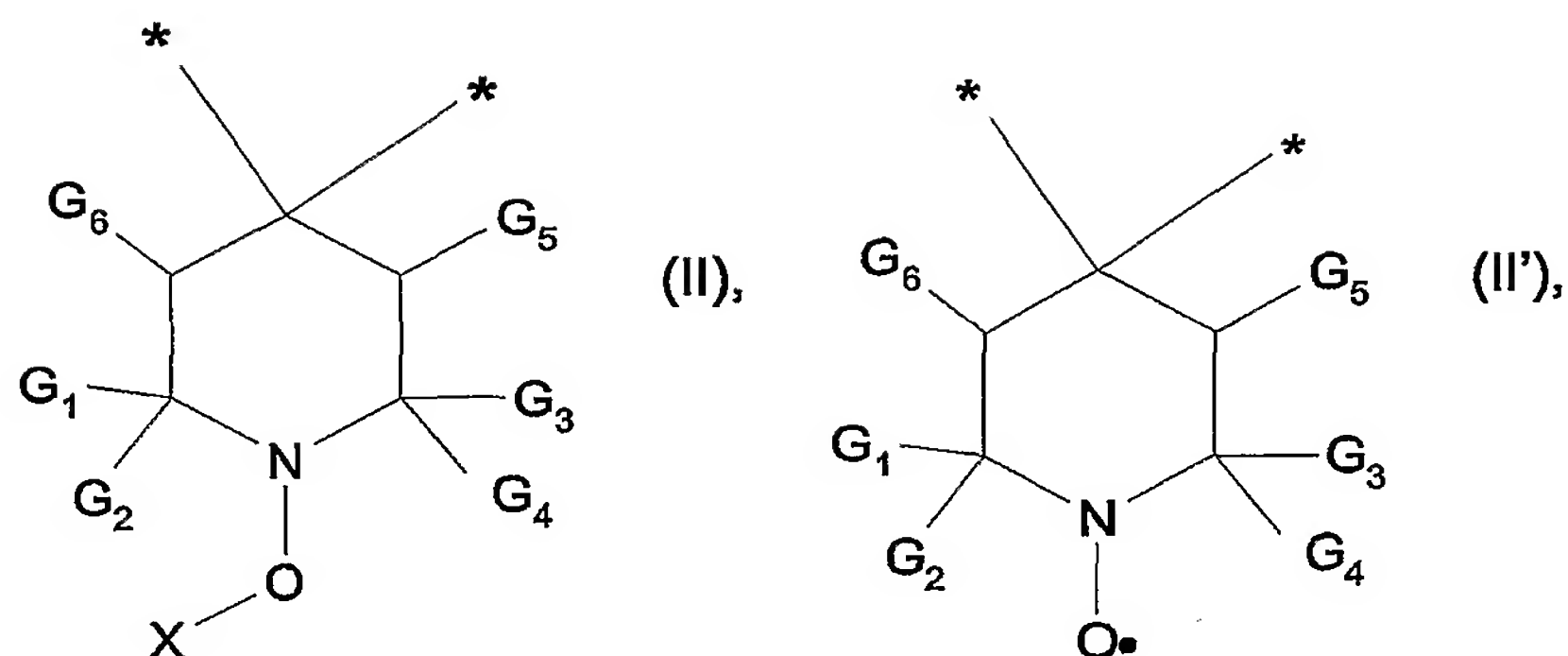
element  $\begin{array}{c} \diagup \\ \text{N}-\text{O}\cdot \\ \diagdown \end{array}$  and a radical initiator.

6. A coating composition according to claim 5 wherein the structural element  $\begin{array}{c} \diagup \\ \text{N}-\text{O}-\text{X} \\ \diagdown \end{array}$

20 is a structural element of formula (II) and the structural element  $\begin{array}{c} \diagup \\ \text{N}-\text{O}\cdot \\ \diagdown \end{array}$  is a structural

element of formula (II')

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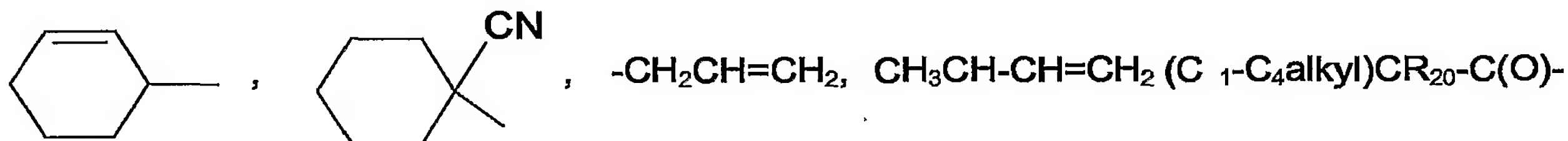
wherein

$G_1, G_2, G_3, G_4$  are independently  $C_1$ - $C_6$ alkyl or  $G_1$  and  $G_2$  or  $G_3$  and  $G_4$ , or  $G_1$  and  $G_2$  and  $G_3$  and  $G_4$  together form a  $C_5$ - $C_{12}$ cycloalkyl group;

5  $G_5, G_6$  independently are H,  $C_1$ - $C_{18}$ alkyl, phenyl, naphthyl or a group  $COOC_1$ - $C_{18}$ alkyl;

X is selected from the group consisting of

- $CH_2$ -phenyl,  $CH_3CH$ -phenyl,  $(CH_3)_2C$ -phenyl,  $(C_5$ - $C_6$ cycloalkyl) $_2CCN$ ,  $(CH_3)_2CCN$ ,



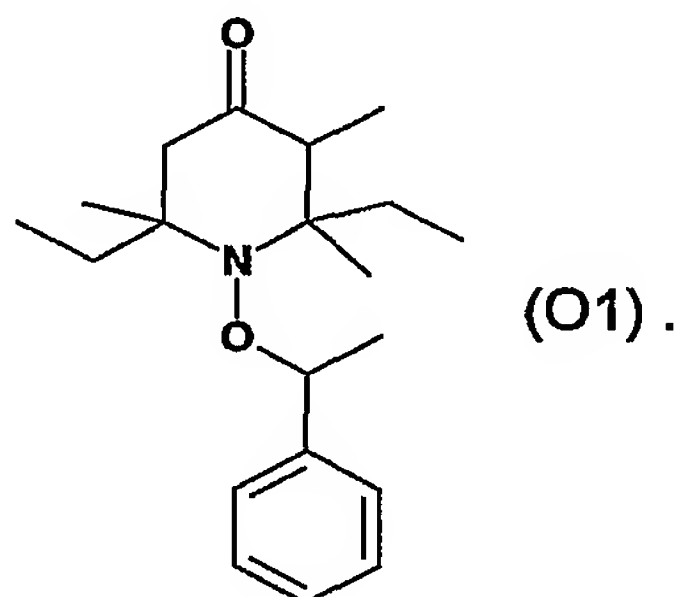
phenyl,  $(C_1$ - $C_4$ )alkyl- $CR_{20}-C(O)-(C_1$ - $C_4$ )alkoxy,  $(C_1$ - $C_4$ )alkyl- $CR_{20}-C(O)-(C_1$ - $C_4$ )alkyl,  $(C_1$ -

10  $C_4$ )alkyl- $CR_{20}-C(O)-N$ -di( $C_1$ - $C_4$ )alkyl,  $(C_1$ - $C_4$ )alkyl- $CR_{20}-C(O)-NH(C_1$ - $C_4$ )alkyl,  $(C_1$ - $C_4$ )alkyl- $CR_{20}-C(O)-NH_2$ , wherein

$R_{20}$  is hydrogen or  $(C_1$ - $C_4$ )alkyl and

\* denotes a valence.

15 7. A coating composition according to claim 6 wherein the structural element of formula (II) is a compound of formula (O1)



8. A coating composition according to claim 1 wherein the levelling agent, component b), has a polydispersity of between 1.0 and 2.0.

9. A coating composition according to claim 1 wherein the levelling agent, component b), has a glass transition temperature between 20° C and 200° C.

5 10. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, based on the weight of total monomers.

10 11. A coating composition according to claim 1 wherein the levelling agent, component b), is a linear polymer or copolymer, i.e. in formula (I) n is 1.

12. A coating composition according to claim 1 wherein in formula (I), component b), y is 1.

15 13. A coating composition according to claim 1 wherein the levelling agent, component b), has a molecular weight of between 3000 to 50000 g/mol (Dalton).

20 14. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 30 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate, and 0.5 to 50 % of a functional monomer which is selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C<sub>1</sub>-C<sub>6</sub>)hydroxyalkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>6</sub>)hydroxyalkyl esters, acrylic acid (C<sub>1</sub>-C<sub>6</sub>)alkyl esters and methacrylic acid (C<sub>1</sub>-C<sub>6</sub>)alkyl esters which are substituted by amino, (C<sub>1</sub>-C<sub>6</sub>)alkylamino, (C<sub>1</sub>-C<sub>6</sub>)dialkylamino, epoxy, fluoro, perfluoro or siloxane groups.

25 15. A coating composition according to claim 1 wherein the levelling agent, component b), is composed of at least 50 % by weight of tert.-butylacrylate and/or tert.-butylmethacrylate and is a solid at room temperature.

30 16. A coating composition according to claim 1 wherein the levelling agent, component b), is present in an amount of 0.1 to 15% by weight, based on the weight of the film forming binder resin or resins, component a).

17. A process for improving the levelling of a coating composition according to claim 1, which process comprises the steps

applying the coating composition to a substrate and exposing it to thermal energy or electromagnetic radiation in order to obtain a homogenous solid coating.

18. Use of a polymer or copolymer of formula (I),  $\text{In}-[(\text{M})_x(\text{E})_y]_n$  (I) obtained by nitroxyl mediated controlled free radical polymerisation wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters or methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters which are substituted by amino, (C<sub>1</sub>-C<sub>22</sub>)alkylamino, (C<sub>1</sub>-C<sub>22</sub>)dialkylamino, -SO<sub>3</sub>H, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, N,N-di(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

provided that the amount of unsubstituted acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters or/and methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters is more than 30 % by weight based on the weight of the total monomer mixture;

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group, which results from a substitution or elimination reaction of the attached stable free nitroxyl radical;

x is the total number of monomer units, which is a number between 5 and 5000;

y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)<sub>x</sub>;

n is a number from 1 to 20;

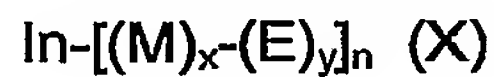
as a levelling agent for a coating composition comprising

- a1) a physically drying film forming binder resin or resins;
- a2) a thermally cross linking film forming binder resin or binder resins;
- a3) a radiation curable film forming binder resin or binder resins;
- a4) an autoxidatively drying film forming binder resin or resins; or
- a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4).

19. A coating composition comprising

- a1) a physically drying film forming binder resin or resins;
- a2) a thermally cross linking film forming binder resin or binder resins;
- a3) a radiation curable film forming binder resin or binder resins;
- 5 a4) an autoxidatively drying film forming binder resin or resins; or
- a5) a combination of binder resins with at least two different crosslinking mechanisms selected from a1), a2), a3) or a4);

b) a polymer or copolymer levelling agent of formula (X), prepared by atom transfer radical polymerisation



wherein

In is the initiator fragment starting the polymerisation reaction;

M is at least one monomer selected from the group consisting of acrylic acid, methacrylic acid, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters, methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)hydroxyalkyl esters, acrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters or methacrylic acid (C<sub>1</sub>-C<sub>22</sub>)alkyl esters which are substituted by amino, (C<sub>1</sub>-C<sub>22</sub>)alkylamino, (C<sub>1</sub>-C<sub>22</sub>)dialkylamino, -SO<sub>3</sub>H, epoxy, fluoro, perfluoro or siloxane groups, styrene, substituted styrene, acrylamide and methacrylamide, N-mono(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, N,N-di(C<sub>1</sub>-C<sub>22</sub>)alkyl acrylamide, and a multifunctional monomer with two or more ethylenically unsaturated bonds;

with the proviso that the amount of tert.-butylacrylate is more than 30 % by weight, based on the weight of the total monomer mixture;

E is Cl, Br or a group introduced by nucleophilic substitution of Cl or Br;

x is the total number of monomer units, which is a number between 5 and 5000;

y is a number 1 or greater than 1 indicating the average number of end groups E attached to the monomer sequence (M)<sub>x</sub>;

n is a number from 1 to 20; and

c) optionally water or/and one or more organic solvents.

20. Use of poly-tert.-butyl acrylate or poly-tert.butylmethacrylate as a levelling agent in powder coating compositions.